4

AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

---

No. 199

---

# BOULTON PAUL P.71A COMMERCIAL AIRPLANE (BRITISH)

A Two-Engine Biplane

---

Washington
March 1935

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

AIRCRAFT CIRCULAR NO. 199

# BOULTON PAUL P.71A COMMERCIAL AIRPLANE (BRITISH)*

## A Two-Engine Biplane

Basically, the Boulton Paul P.71A, a new type for feeder-line work, springs from the "Mailplane"**, details of which were published in Flight for April 6, 1933. There are, however, several structural differences which make it most interesting from an engineering point of view. As with the "Mailplane", it is a two-bay biplano with two engines mounted high up between the wings directly above the widely spread wheels of the landing gear. The engines, which are two Armstrong Siddeley Jaguar VIA's, are mounted on built-up duralumin ring-type mountings slung from the under side of the top wings by steel tubes and built-up girders, and cowled with Townend ring-form cowlings. These mountings coincide with the inner interplane struts and the points at which each separate half of the landing gear is attached beneath the lower wings (figs. 1, 2, 3, and 4).

The sketches (fig. 5) explain the construction of the landing gear, and from the photographs it can be seen how neatly each half is faired in. The Dunlop wheels, which have Dunlop brakes, are carried between oleo-pneumatic shock-absorbing legs. The fairings are detachable and are fabric-covered structures of spruce, light stringers being bent around formers to carry the fabric. This system of building up fairings has been used for a number of other places on the airplane, notably under and above the fuselage, between the wings, and around the nose of the fuselage, their detachability being a useful feature.

Fuel is carried in four riveted duralumin tanks. Two, having a capacity of 65 gallons each, are placed one on each side of the fuselage in the roots of the top wing center section; the other two, of 28 gallons each, are mounted one on each side in the top wing sections outside the engines. The lubricating oil tanks are of the same

---

* From Flight, January 31, 1935.

**See N.A.C.A. Aircraft Circular No. 177, "The Boulton and Paul P.64 Mail-Carrier."

construction and form part of the leading edge of the top wings above each engine.

No hard-and-fast rule has been adhered to with regard to the material used for construction in the P.71A. In many places light alloy is used extensively, while in others, where the stresses are high, steel has been used. Even the form of construction has been varied considerably. The front end of the fuselage, where it forms the pilot's cockpit, consists mainly of duralumin tubes secured at the joints either by flattening the tube ends and riveting them between flitch plates, or by using machined fittings. The rear half of the fuselage - that is, abaft the passenger cabin and luggage compartment - is also built up in the same manner with duralumin tubes bracing steel longerons, but is covered with doped fabric stretched over spruce formers and stringers. (See figs 6 and 8.)

The center portion of the fuselage is entirely different in construction. Its general form is somewhat analagous to flying-boat-building practice, that is to say, the main structure is formed of built-up channel section duralumin girders over which is riveted a corrugated Alclad sheet covering. This center portion forms the passenger cabin, with accommodation for a maximum of 14 passengers. At the front end of the cabin, just behind a bulkhead which separates it from the pilot's cockpit - access to which is by a large door, and which, incidentally, has a "sunshine" roof made to slide open easily - there is a well-fitted lavatory (fig. 7).

Particular attention has been paid to the comfort provided for the passengers. The cabin ventilation is on the "total" system, that is to say, warm or cold air is introduced through a large single inlet and exhausted in the same manner, the system being so arranged that all the air in the cabin is changed continuously. All the furniture and fitments in the cabin, as well as the soundproofing have been looked after, the latter being achieved in part by a padding of "Sepak" in the space - the depth of the structural girders - left of necessity between the outer Alclad shell and the inner lining.

A point of interest is the system adopted for operation of the controls. From the pilot's cockpit to the controllable surfaces there are, for the most part, tie rods; where it is necessary to carry them around corners

they are connected to chains running over sprockets. Numbers of inspection doors are provided, while the detachable fairing around the cockpit makes inspection of the whole system a simple matter. A locking device secures the controls when on the ground, and prevents damage due to flapping in the wind.

The tail units are unusual. The stabilizer is a monoplane with a built-up duralumin spar and ribs of the same material, and is adjustable for trim by a screw gear. It carries a single central fin, also of metal construction, and two rudders. These latter are placed well toward the ends of the stabilizer spar, one on each side of the fin. Rudder posts project above and below the spar and operate top and bottom rudder surfaces. The Dowty tail wheel is of the streamline and self-centering type - a small point which saves quite a considerable drag when, as in the P.71A, cruising speeds of 150 miles per hour are attained.

From an engineering point of view the P.71A is extremely interesting; the way in which different materials are used according to the work they have to perform shows that much thought has been put into producing a sound structure. The ratio of gross weight to tare weight is 1.56, a good average figure, probably sufficient to make the P.71A a sound commercial proposition for the work for which it is required, but scarcely high enough to allow it to be used really economically over long distances.

One of its more attractive features is its performance on one engine; a ceiling of 4,500 ft. (1,372 m) is claimed on either engine. The comparatively low wing loading - only 13.25 lb./sq.ft. (64.7 kg/$m^2$) - and low power loading of about 11.17 lb./hp. (5 kg/hp) should ensure a good performance at airports which are situated at a high altitude and in countries where the heat affects the performance adversely; it would seem probable that it is for conditions of this nature that Imperial Airways have made these two latest additions to their fleet. Certainly, for overseas conditions particularly, where the airports are soft or where the run available for taking off is short, an airplane which takes off with full load in 200 yards (183 m) and lands in the same distance should be a blessing and a joy to the pilots, as well as a saving from the point of view of airport costs.

## Two Siddeley Jaguar VIA Engines

Dimensions:

| | | |
|---|---|---|
| Span of wing, top | 54 ft. 0 in. | 16.45 m |
| Height, over-all | 15 " 2-1/4 in. | 4.57 " |
| Length, over-all | 44 " 2 in. | 13.46 " |
| Mean chord | 6 " 10 " | 2.08 " |
| Aspect ratio | 7.91 | |
| Dihedral | 3.5° outer bays | |
| Sweepback | 2.86° | |

Areas:

| | | |
|---|---|---|
| Main wings with ailerons | 718.5 sq.ft. | 66.75 $m^2$ |
| Ailerons, total | 76.0 " " | 7.06 $m^2$ |
| Stabilizer | 45.5 " " | 4.23 $m^2$ |
| Elevators | 34.7 " " | 3.22 $m^2$ |
| Fin | 12.7 " " | 1.17 $m^2$ |
| Rudder, total | 40.5 " " | 3.76 $m^2$ |

Weights:

| | | |
|---|---|---|
| Tare weight | 6,100 lb. | 2,766.9 kg |
| Pay load | 1,510 " | 684.9 " |
| Crew (two) | 360 " | 163.3 " |
| Fuel and oil, normal | 1,080 " | 489.9 " |
| Cabin equipment, wireless, etc. | 450 " | 204.1 " |
| Maximum permissible | 9,500 " | 4,309.1 " |

Loadings and ratios:

| | | |
|---|---|---|
| Wing loading | 13.25 lb./sq.ft. | 64.6 kg/m$^2$ |
| Power loading | 11.17 lb./hp. | 5 kg/hp |
| Ratio of gross weight to tare weight | 1.56 | |

Performance:

| | | |
|---|---|---|
| Stalling speed, full load | 62 m.p.h. | 99.7 km/h |
| Cruising speed | 150 " at 4,500 ft. | 241.4 " 1,371.6 m |
| Take-off run, no wind, full load | 200 yd. | 182.9 m |
| Landing run, no wind, full load | 200 yd. | 182.9 m |
| Service ceiling | 21,000 ft. | 6,400.8 m |
| Service ceiling on one engine | 4,500 ft. | 1,371.6 m |
| Rate of climb, sea level | 1,400 ft./min. | 7.11 m/s |
| Climb to 4,500 ft. (1,371.6 m) | 4.5 min. | |
| Range, normal | 420 miles | 675.9 km |
| Range, full tanks | 600 miles | 965.6 km |

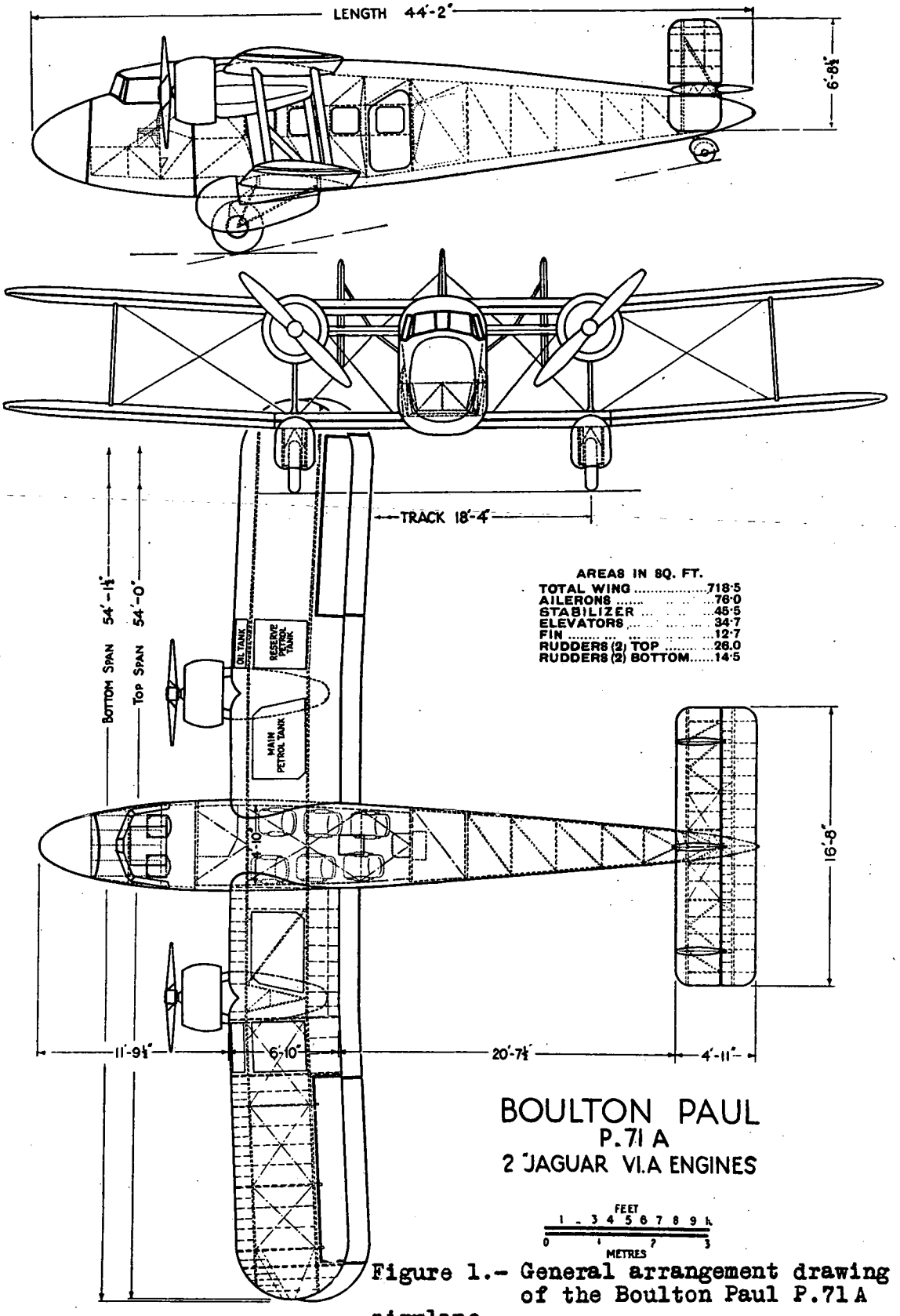



Figure 1.- General arrangement drawing of the Boulton Paul P.71 A airplane.

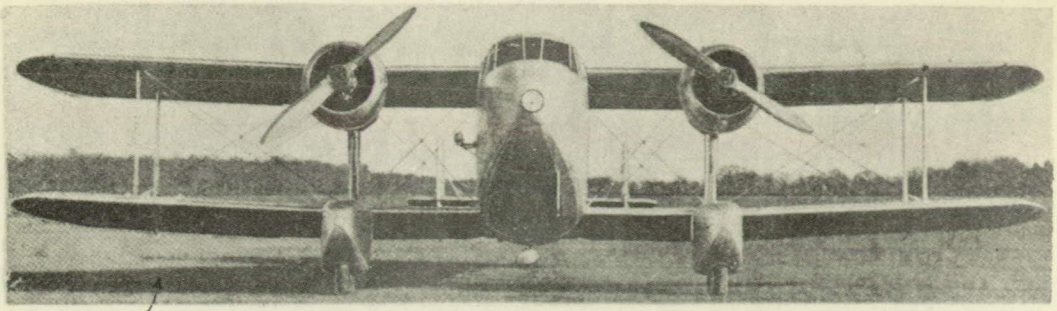
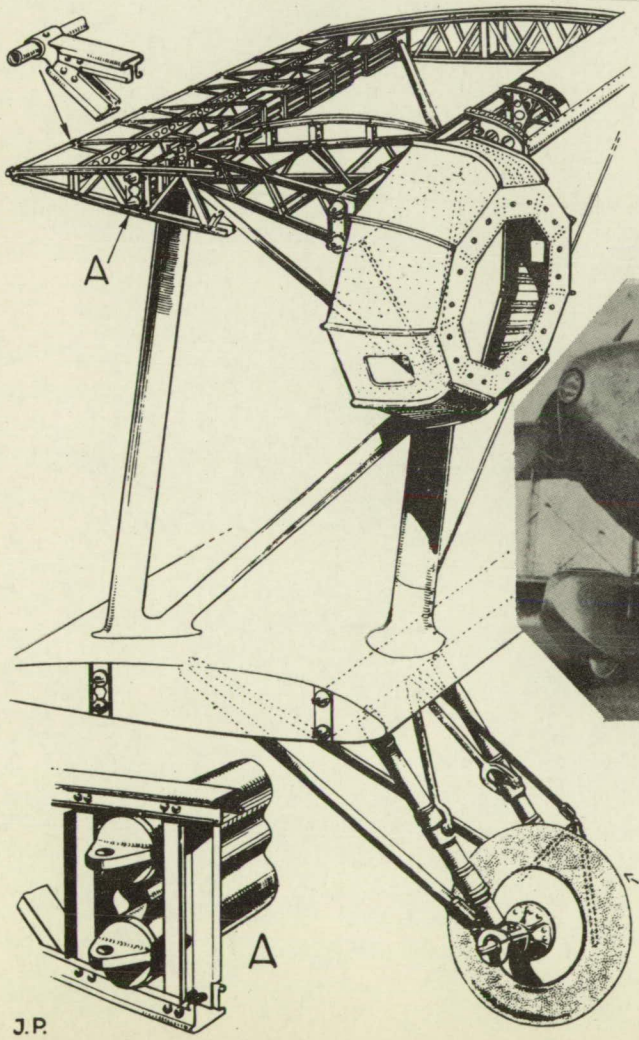


Figure 2.- Front view of the Boulton Paul P. 71A airplane showing a very clean design


Figure 3.- The Boulton Paul P.71A in flight.



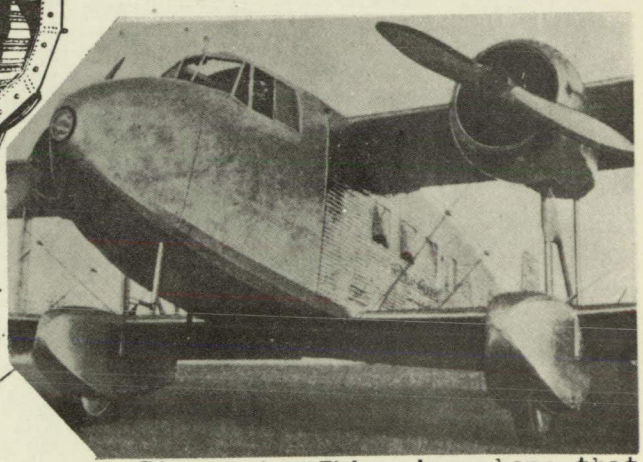



Figure 4.- This view shows that the pilot has an excellent outlook forward.

Figure 5.- This sketch shows structural details of the engine mounting and landing gear.

J.P.

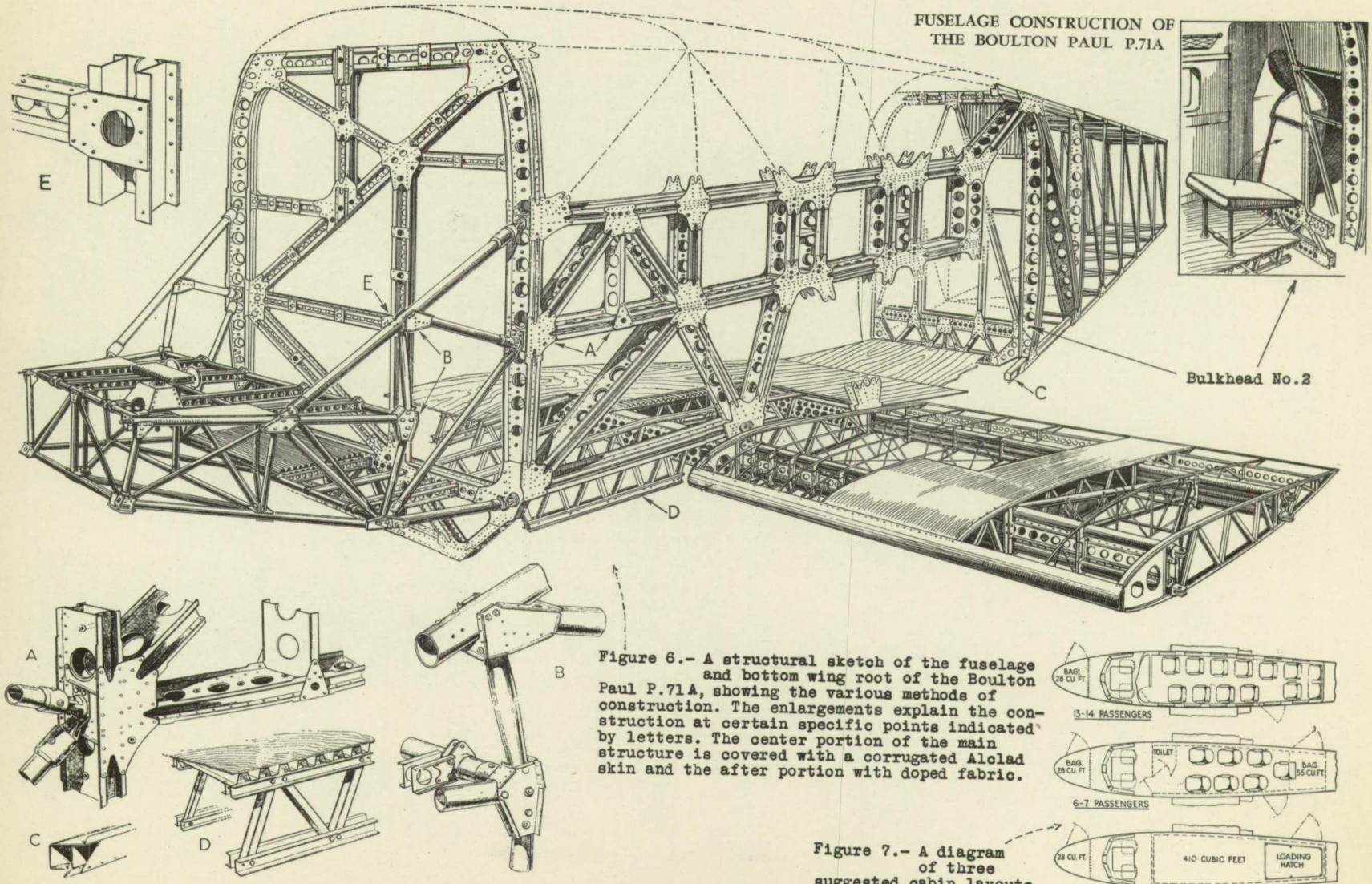



Figure 6.- A structural sketch of the fuselage and bottom wing root of the Boulton Paul P.71A, showing the various methods of construction. The enlargements explain the construction at certain specific points indicated by letters. The center portion of the main structure is covered with a corrugated Alclad skin and the after portion with doped fabric.




Figure 7.- A diagram of three suggested cabin layouts.

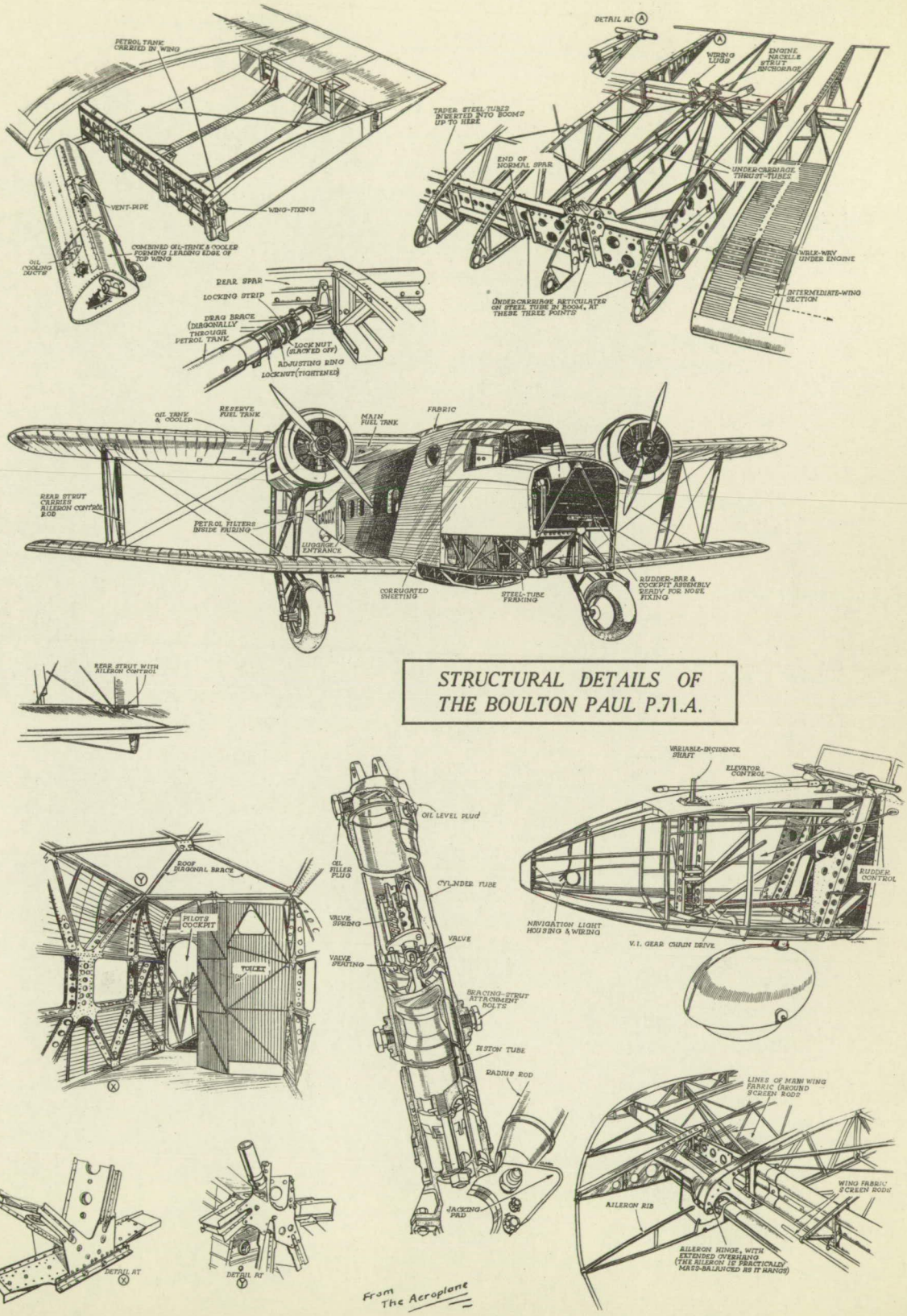

PETROL TANK CARRIED IN WING
VENT-PIPE
WING-FIXING
COMBINED OIL-TANK & COOLER FORMING LEADING EDGE OF TOP WING
OIL COOLING LOUVRES
DETAIL AT (A)
WIRING LUGS
ENGINE NACELLE STRUT ANCHORAGE
TAPER STEEL TUBES INSERTED INTO BOOMS UP TO HERE
END OF NORMAL SPAR
UNDER-CARRIAGE THRUST-TUBES
WALK-WAY UNDER ENGINE
INTERMEDIATE-WING SECTION
UNDER-CARRIAGE ARTICULATED ON STEEL TUBE IN BOOM, AT THESE THREE POINTS
REAR SPAR
LOCKING STRIP
DRAG BRACE (DIAGONALLY THROUGH PETROL TANK)
LOCK-NUT (SLOTTED OFF)
ADJUSTING RING
LOCK-NUT (TIGHTENED)
OIL TANK & COOLER
RESERVE FUEL TANK
MAIN FUEL TANK
FABRIC
REAR STRUT CARRIES AILERON CONTROL ROD
PETROL FILTERS INSIDE FAIRING
WINDSCREEN
ENTRANCE
CORRUGATED SHEETING
STEEL-TUBE FAIRING
RUDDER-BAR & COCKPIT ASSEMBLY READY FOR NOSE FIXING
REAR STRUT WITH AILERON CONTROL
STRUCTURAL DETAILS OF THE BOULTON PAUL P.71.A.
OIL LEVEL PLUG
OIL FILLER PLUG
CYLINDER TUBE
VALVE SPRING
VALVE
VALVE SEATING
BRACING-STRUT ATTACHMENT BOLTS
PISTON TUBE
RADIUS ROD
JACKING PAD
BOOM DIAGONAL BRACE
PILOT'S COCKPIT
TOILET
DETAIL AT (X)
DETAIL AT (Y)
VARIABLE-INCIDENCE SHAFT
ELEVATOR CONTROL
RUDDER CONTROL
NAVIGATION LIGHT HOUSING & WIRING
V.I. GEAR CHAIN DRIVE
LINES OF MAIN WING FABRIC (AROUND SCREEN RODS)
WING FABRIC SCREEN RODS
AILERON RIB
AILERON HINGE, WITH EXTENDED OVERHANG (THE AILERON IS PRACTICALLY MASS-BALANCED AS IT HANGS)
From The Aeroplane

Figure 8.